Occupancy Sensor Technologies:
Microphonics vs. Ultrasonic

Introduction

In a world of rising energy costs and declining budgets, the need for energy conservation has reached an all-time high. One way that commercial and industrial companies and institutions can reduce their energy consumption is through the use of lighting occupancy sensors. This paper will discuss how savings can be realized with occupancy sensors, review various types of sensor technologies used in these devices, and analyze why new Microphonics technology surpasses the widely used yet inferior ultrasonic technology.

Occupancy Sensors' Positive Affect On the Bottom Line

Occupancy sensors are devices that sense when a person enters a room or space, and automatically activates the lights in that area. When the person leaves the space, the lights automatically turn off and remain off until the space is once again occupied. Occupancy sensors allow lights to be turned on only when and where needed.

Although simple in concept, the resulting energy and cost savings of this technology is enormous. In most corporate settings it is typical that lights remain on in unoccupied conference rooms, in offices while someone steps out for lunch, in areas of warehouses not in use, and in unoccupied lavatories. This unnecessary lighting amounts to much wasted energy and huge energy costs.

Estimates on how much energy is consumed by lighting can range as high as 70% or more in certain applications. Keeping lights turned on only when needed and where needed can truly affect a company's bottom line. In fact, time after time, it is shown that when a company incorporates occupancy sensors into its lighting infrastructure, they can reduce their energy consumption by up to 50%.

PIR Technology

When motion detectors were first introduced in the United States the 1970s, they used Passive Infrared (PIR) technology. Today, the advancements in PIR technology have allowed for the development of modern lighting control systems.

Passive Infrared technology detects human body temperature and registers occupancy of a space as a person moves across the sensor's switching zones. The more switching zones that a sensor has, the more sensitive it is to small movements. PIR sensors are relatively immune to false activation (tripping) of lights.

PIR sensors require direct line of sight and are best used in open areas such as open office plans with no partitions, factory floors, classrooms, and individual offices. Because range can be

limited when sight lines are obstructed such as in open offices with partitions or irregularly shaped areas, PIR is oftentimes used in conjunction with other sensor technologies such as Microphonics or ultrasonic. This combination of technologies is referred to a Dual Technology.

Microphonics Technology

Microphonics is an advanced detection technology that has been patented by Sensor Switch, Inc., an Acuity Brands company, located in Wallingford, Connecticut. Microphonics utilizes a microphone inside of the sensor to literally hear sounds that indicate occupancy. Microphonics technology is especially useful in rooms with obstructions such as bathrooms with stalls or open office environments with cubicles partitions.

One of the great benefits of Microphonics technology is its ability to distinguish the sounds made by human activity from ambient noise. It can detect noises such as talking, eating, typing, and other sounds in the area that are typical of human activity. It masks out and does not recognize noises made by the building or the environment such as the sound of the HVAC system, air currents, equipment, cars driving by, etc.

Microphonics technology also makes use of Automatic Gain Control (AGC) to dynamically self-adapt the sensor to its environment by filtering out constant background noise. In addition, Microphonics uses advanced digital acoustic filtering. This prevents the prolonged presence of varying noises such as a television or radio from keeping the lights on unnecessarily. It can also filter out sounds with periodicity, such as the constant ticking of a clock.

Lastly, in addition the benefits mentioned above, Microphonics technology uses less power and is acoustically passive, meaning no sound waves are transmitted into a space, thus eliminating all potential for interference (see ultrasonic technology below).

PIR/Microphonics Dual Technology

Microphonics technology was designed as a secondary detection method to PIR, and is only used in Dual Technology sensors when it is paired with PIR. This combination of technologies, referred to as Passive Dual Technology (PDT), ensures optimum reliability and accuracy of occupancy detection. With PDT, it is the PIR technology that initially detects motion and activates the lighting, after which continued motion (PIR) or sound (Microphonics) keeps the lighting on until the space is no longer occupied. This combination of technologies is very reliable, accurate, and completely passive, which results in significant energy savings.

Ultrasonic Technology

Ultrasonic sensors sense movement in a space by transmitting high frequency sound waves, which they then receive back as a reflected signal using the Doppler Effect. An ultrasonic sensor floods an area within its coverage pattern with this high-frequency sound. Any moving object within its coverage area will disturb the sound wave pattern, and will activate the lighting.

One advantage of ultrasonic occupancy sensors is that their sound pattern can detect occupancy behind partitions, solid walls, and other obstructions. However, this ability is also a disadvantage since these sensors may also detect occupancy in areas not intended to be included in the coverage area such as adjacent hallways, the attic or roof, and outside of windows.

Sensors that use ultrasonic technology also cannot distinguish between human and non-human motion. As a result, they are prone to false activation (tripping) from vibrations, air currents, hanging objects, high sound levels, sounds having ultrasonic components, and building-type movements. For example, ultrasonic sensors can turn on a building's lights regularly during the night whenever the air conditioning system kicks on.

To combat these problems, ultrasonic sensors have incorporated sensitivity adjustments. However, while these adjustments minimize false tripping of the lights, they also reduce the coverage area and rely heavily on the installer to function properly, In addition, if ultrasonic sensors are mounted close to each other, they must operate at different frequencies to avoid interfering with one another.

Lastly, due to the fact that ultrasonic technology is based on high intensity sound waves being transmitted into a space at all times, there is potential that these wave will cause interference with office devices such as wipe-board readers or even hearing aids. While product modifications attempt to ensure that ultrasonic frequencies used in sensors do not interfere with hearing aids, the potential for interference will never be fully eliminated due to the constant sound waves being emitted by these sensors.

PIR/Ultrasonic Dual Technology

Whether used alone or in dual technology with PIR, ultrasonic technology faces the same advantages and limitations.

Summary: Microphonics vs. Ultrasonics

Feature	Microphonics	Ultrasonics
Detects human presence	Yes	Yes
Reliably filters out non-human presence	Yes	No
Useful in rooms with obstructions	Yes	Somewhat
Prone to false tripping	No	Yes
Installer Involvement required	No	Yes
Prone to Interference	No	Yes

Summary

Because lights are activated only when and where needed, there is no doubt of the energy conservation and resulting lowered operating expense realized by using occupancy sensors. However, to achieve the highest savings, it is imperative to select a sensor technology that will provide the most benefits and least amount of false tripping. As illustrated above, there are many drawbacks to using ultrasonic technology in occupancy sensors, including false tripping, the need for installer involvement, frequency variances, and interference. In contrast, the use of Microphonics technology, especially in PIR/Microphonics dual technology, eliminates these drawbacks and provides effective, reliable and accurate human detection in occupancy sensors.